
Hollandmey Renewable Energy Development
Environmental Impact Assessment Report
Technical Appendix 8.4: Fish Habitat Survey



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1 INTRODUCTION

1.1.1 This Technical Appendix has been prepared to accompany **Chapter 8: Ecology and Biodiversity**, of the Hollandmey Renewable Energy (RED) (hereafter the 'proposed Development') Environmental Impact Assessment (EIA) Report.

1.1.2 It presents detailed methodologies and results of desk studies and field survey completed to establish baseline conditions with regards to fisheries. This was in order to identify any potentially important/critical fish habitat which may be impacted by the proposed Development and to inform any required changes to scheme design and the requirement for mitigation.

1.1.3 It should be read with specific reference to the following figures presented in Volume 3 of the EIA Report:

- **Figure 8.1** – Designated Sites for Nature Conservation; and,
- **Figure 8.5**– Fish Habitat Plan.

1.1.4 The following species of conservation significance are considered:

- European eel *Anguilla anguilla* - Council Regulation (EC) No 1100/ 2007) establishing measures for the recovery of the stock of European eel; listed by International Union for Conservation of Nature (IUCN) as 'Critically Endangered', listed on the Scottish Biodiversity List (SBL) (Watching Brief Only) and listed as a UK Biodiversity Action Plan (BAP) Priority Species;
- Atlantic salmon *Salmo salar* – listed on Annex II of Habitats Directive¹, Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003, SBL (Conservation Action Needed & Avoid Negative Impacts) and listed as a UK BAP Priority Species;
- Brown trout/sea trout *Salmo trutta* – listed on the SBL (Conservation Action Needed) and as a UK BAP Priority Species;
- River lamprey *Lampetra fluviatilis* – listed on Annex II of Habitats Directive, SBL (Avoid Negative Impacts) and listed as a UK BAP Priority Species;
- Brook lamprey *Lampetra planeri* – listed on Annex II of Habitats Directive, SBL (Avoid Negative Impacts); and,
- Sea lamprey *Petromyzon marinus* – listed on Annex II of Habitats Directive, SBL (Avoid Negative Impacts) and listed as a UK BAP Priority Species.

1.2 Site Overview

1.2.1 The Site is located approximately 8 km to the south east of Dunnet Head in Caithness, Scotland. The Hamlet of Mey lies to the north of the Site.

1.2.2 The Site largely comprises commercial forestry plantation woodland, interspersed with areas of bog, heathland and grassland habitats, which are grazed in parts with sheep and cattle. The surrounding landscape comprises similar open ground used for rough grazing.

¹ Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

- 1.2.3 The Phillips Mains Mire Site of Special Scientific Interest (SSSI), designated by virtue of its blanket bog and dubh lochan interests occupies the north eastern extent of the Site.
- 1.2.4 Occasional small shallow burns tribute through the Site, with the most substantial watercourse comprising the Link Burn, which flows through the Site in a predominantly westerly direction. The headwaters of the Link Burn comprise the Burn of Hollandmey and an unnamed tributary, which also flow through the Site.
- 1.2.5 To the north of the Link Burn the Burn of Ormigill also flows through the Site to the west, before joining with the Link Burn where they become the Burn of Rattar, which enters the sea to the west of Skarfskerry.
- 1.2.6 The headwater of the West Burn of Gills lies at the northern extent of the Site. Also in the north of the Site lie unnamed headwaters, which, to the north, form the Burn of Horsegrow, which tributes into the Loch of Mey. On the eastern extent of the Site lie a series of field drains and unnamed, minor watercourses which tribute into a roadside drainage ditch, prior to discharging into the headwaters of the Gill Burn and the Back Burn of Slickly. At the southern extent of the site are further minor, almost undeterminable watercourses, which form part of the headwaters of the Burn of Slickly.

2 METHODOLOGY

2.1 Desk Study and Consultation

- 2.1.1 A desk study was undertaken to identify the proximity of the Site to any statutory or non-statutory designated site for nature conservation and any classified waterbodies and existing fisheries records within the Site and surrounding area.
- 2.1.2 The following key publicly sources were consulted:
- SiteLink²;
 - The Scottish Environment Protection Agency (SEPA) River Basin Management Plan³;
 - The Flow Country Fisheries Management Organisation (FCFMO) Draft Fisheries Management Plan: 2016; and,
 - 2019 Survey of Juvenile Salmonids in the Caithness Rivers – Caithness District Salmon Fisheries Board: 2020.
- 2.1.3 Consultation was also undertaken with the following consultees:
- NatureScot (formerly Scottish Natural Heritage (SNH));
 - Fisheries Management Scotland (FMS);
 - Caithness District Salmon Fishery Board (CDSFB);
 - Flow Country Rivers Trust (FCRT); and,
 - Highland Biological Recording Group (HBRG).

² <https://sitelink.nature.scot/home> [Accessed July 2020].

³ <https://www.sepa.org.uk/data-visualisation/water-environment-hub> [Accessed July 2020].

2.1.4 Further details of consultations are provided in **Chapter 8: Ecology and Biodiversity**, of the EIA Report.

2.2 Fish Habitat Survey

2.2.1 A fish habitat survey was completed of all watercourses within the Site in July 2020.

2.2.2 The survey aimed to identify any areas of critical fish habitat within the study area including spawning, nursery areas, juvenile and adult holding areas, and lamprey *Lampetra spp.* habitat.

2.2.3 An initial gradient analysis of the study area was completed based on the contour intervals in GIS, and during an initial walkover prior to survey. This allows identification of all linear 100 m stretches of watercourses within the study site with a gradient of $\geq 6\%$.

2.2.4 Such stretches of watercourses with a gradient of $\geq 6\%$ are considered to be unsuitable or non-productive fish habitat for Atlantic salmon and brown/sea trout. Mills (1973) found that gradients of $< 3\%$ were favourable for Atlantic salmon; whilst sea trout were found to spawn in streams with gradients up to 4%. Most populations of lamprey occur where the average stream gradient is 1.9 – 5.7 m/km, being rarely found where gradients exceed 7.8 m/km or 0.78% (Maitland and Campbell, 1992). Whilst gradients of $\geq 6\%$ are considered to be typically unsuitable for fish fauna, it is recognised that small, isolated, populations of brown trout may occur in locally suitable habitat in stretches with steeper gradients.

2.2.5 No such watercourses were identified within the Site.

2.2.6 The watercourses within the study area were subsequently systematically walked (including in-stream inspections where required) and the habitats mapped according to the classification presented in **Table 2.1**.

2.2.7 Specifically, the habitat survey focused on the identification of the following:

- Spawning habitat for salmonid and lamprey species;
- Nursery habitat for lamprey species;
- Areas of habitat important for juvenile salmonids (fry and parr); and,
- Areas of habitat important for adult holding areas.

2.2.8 The habitat classification methodology used followed that of the Scottish Fisheries Co-ordination Centre’s Habitat Surveys Training Course Manual (SFCC, 2007), the Environment Agency’s Restoration of Riverine Salmon Habitats Guidance Manual (Hendry & Cragg-Hine, 1997), and a review of key habitat requirements for other species of conservation significance including lamprey and salmonids (e.g. Maitland, 2003; Hendry & Cragg-Hine, 2003).

2.2.9 Each watercourse was walked in full across its extent within the Site. Detailed analysis was undertaken at selected sample points for each watercourse. Samples were taken at each of the representative sections of each watercourse and where varying watercourse structure, flow conditions or bankside use was evident. The following information was collected at each sample location: channel gradient; substrate composition (% bedrock, boulders > 256 mm, cobbles 65-256 mm, pebbles 4-64 mm, gravel 2-4 mm, coarse sand 0.5-2 mm and fine sand/silt/peat < 0.5 mm); average wetted channel width (m); average depth (m) and turbidity (1 [clear] – 3 [turbid]). Any potential barriers to fish movement within watercourses were also recorded and a photograph was taken at each sample point.

Table 2.1: Fish river habitat classifications.

Cat.	Habitat Type	Description	Species Suitability
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1 1a 1b 1c	Unsuitable Steep > 10% gradient 6-10% gradient Other – ephemeral, shallow drains, dry beds	Usually 1 st – 2 nd order watercourses with steep gradient, ≥6% slopes (often substantially greater), abundant bedrock, lack of fixed substrates, high velocity (e.g. headwaters/rivulets). Also includes less steep ephemeral stretches (e.g. headwater sources), shallow drains and modified watercourses with dry beds.	No productive fish habitat, although some species may migrate through these areas (also refer to 7. Rapids) depending on whether they represent a migration barrier.
2 2a 2b	Spawning Habitat Salmonids Lamprey	Stable “gravels” of minimum 15-30 cm depth, optimal 20-30 mm, not compacted or with excessive silt/sands (<20% by weight) for salmonids. Lamprey spawning habitat where “gravels” include sands. Often at tail end of pools or upstream ends of riffle-runs ensuring oxygenated substrate. Can also be found at end of weir pools.	Spawning habitat - Atlantic salmon (c. 9 m ² per pair) and sea/brown trout; lamprey.
3	Riffle	Shallow (< 20 cm) and fast flowing, with upstream-facing wavelets which are unbroken (although often some broken water), with substrate dominated by gravel and cobbles.	Fry (0+) habitat – Atlantic salmon/ brown trout/sea trout.
4 4a 4b	Run Shallow (< 0.5 m deep) Deep (>0.5 m deep)	Generally deeper (20-40 cm) and less steep bed compared to riffle, with substrate of boulders, cobbles and gravels. Usually disturbed, rippled surface. Often located immediately downstream of riffle.	Mixed salmonid juvenile habitat. Fry (0+) & Par (1+) habitat - Atlantic salmon/ brown trout/sea trout.
5 5a 5b	Glide Shallow (<0.5 m deep) Deep (> 0.5 m deep)	Shallow gradient stretches with smooth laminar flow with little surface turbulence and generally > 30 cm deep; water flow is silent. Often located below pool.	European eel; non-productive salmonid habitat, although may provide some shelter for adults.
6 6a 6b 6c	Pool Plunge/Scour pool Meander pool Weir/bridge pool	No perceptible flow, eddying and usually > 100 cm deep. Substrate with high proportion of sand and silts. Often located on the outside of meanders, but includes natural scour or plunge pools and artificial weir pools.	Adult refugia Atlantic salmon, sea/brown trout, European eel.
7 7a 7b 7c	Rapids Steep - >10% gradient Moderate - 6-10% gradient Low - <6% gradient	Sections of relatively steep gradient with fast currents and turbulence, with mixed flow types, including free-fall, chutes and broken, with obstructions such as large boulders, rock outcrops and falls.	Negative feature for migratory species and may pose a migratory barrier; elvers and yellow eels limited to velocity of <0.5 m/sec and 2.0 m/sec respectively; lamprey to 2 m/sec.
8 8a 8b	Banks of fine sediment of silts and sands Optimal Sub-optimal	Limited flow (sometimes back-flow) allowing deposition of silts/sands, not anoxic, with/without riparian trees. Optimal habitat is stable fine sediment and sand ≥15 cm deep with some organic detritus. Sub-optimal habitat includes small areas of deposited silts/sands behind boulders.	Lamprey ammocoete nursery and adult refuge.
9 9a 9b 9c 9d 9e	Vegetation features Riparian trees (tunnel) Flow constriction Aquatic macrophytes Emergent macrophytes Large woody debris	Closed woodland canopy forming tunnel vegetation In-stream emergent, boulders Stands of aquatic and floating vegetation Stands of emergent (usually marginal) vegetation LWD forming dams, etc.	Tunnel riparian trees may be negative feature for salmonids, although tree roots and fallen trees may provide refugia for Atlantic salmon/ brown trout/sea trout and European eel. Aquatics/emergents provide cover for fish, particularly juveniles.
10	Obstructions to migration	Impassable waterfalls, rapids, flow constrictions, weirs, bridge sills, culverts, shallow braided river sections, pollution preventing upstream migration.	All migratory species; impassability varies between species. Leaping ability: <3.7 m Atlantic salmon; <1.81 trout; European eel and lamprey none.
11 11a 11b 11c	Other features Side channel Backwater Artificial channel	Includes other channel features, with side channel (connected to main channel) and backwaters. Artificial channels may comprise either man-made banks and/or beds.	Side channel/backwater often important refugia for juveniles. Artificial channels have limited diversity and are often non-productive fish habitat.

Study Area

2.2.10 The study area included all watercourses identified within the Site, shown in **Figure 8.5** of the EIA Report.

Limitations

- 2.2.11 The fish habitat survey was completed within the normal range of flows for watercourses in the geographical area, as defined by Scottish Environmental Protection Agency (SEPA)⁴.
- 2.2.12 The survey is therefore considered not to be subject to any significant limitations.

Fresh Water Pearl Mussel *Margaritifera margaritifera*

- 2.2.13 NatureScot in consultation in August 2020, advised that consideration of freshwater pearl mussel *Margaritifera margaritifera* at the Site, was not required. As such the species is not discussed further within this report, or subsequently within **Chapter 8: Ecology and Biodiversity** of the EIA Report.

3 RESULTS

3.1 Desk Study and Consultation

Designated Sites for Nature Conservation

- 3.1.1 In review of SiteLink and consultation with the HBRG, the Site is not located within 10 km of any statutory designated for nature conservation (**Figure 8.1** of the EIA Report), or within 2 km of any non-statutory designated site with fisheries qualifying interests.

Classified Waterbodies

- 3.1.2 The European Water Framework Directive (WFD) requires that surface waterbodies in member states are classified according to ecological status. SEPA's River Basin Management Plan website (<https://www.sepa.org.uk/data-visualisation/water-environment-hub>) confirms the status of the following watercourses within the study area as illustrated on **Figure 8.5** of the EIA Report:

- W1 & W2 – Headwater of Burn of Horsegrov: Unclassified;
- W3 – Burn of Ormigill: Unclassified;
- W4 – Unnamed tributary of the Burn of Ormigill: Unclassified;
- W5 – Burn of Hollandmae: Unclassified;
- W6 - Link Burn: Good Ecological Status/High Access for Fish Migration;
- W7 – Unnamed tributary of Link Burn: Unclassified;
- W8 – Headwater of West Burn of Gills: Unclassified;
- W9 & W10 – Headwaters of Gills Burn: Unclassified;
- W11 – Headwaters of Back Burn of Slickly: Unclassified; and
- W12 – Headwaters of the Burn of Slickly: Unclassified.

⁴ <http://apps.sepa.org.uk/> [Accessed July 2020].

- 3.1.3 In review of Scotland's Environment Map⁵, there are no known barriers to fish migration identified on the Burn of Hollandmey, Link Burn, Burn of Ormigill, Burn of Rattar, West Burn of Gills or Burn of Horsegrow.
- 3.1.4 The headwater of the West Burn of Gills lies at the northern extent of the Site. Also, in the north of the Site lie unnamed headwaters, which, to the north, form the Burn of Horsegrow, which tributes into the Loch of Mey. On the eastern extent of the Site lie a series of field drains and unnamed, minor watercourses which tribute into a roadside drainage ditch, prior to discharging into the headwaters of the Gill Burn and the Back Burn of Slickly. At the southern extent of the site are further minor, almost undeterminable watercourses, which form part of the headwaters of the Burn of Slickly.

Existing Fisheries Records

- 3.1.5 The known distribution of fish in the geographical area is summarised in the FCFMO Draft Fisheries Management Plan (CDSFB, 2016) and the 2019 Survey of Juvenile Salmonids in the Caithness Rivers (CDSFB, 2020).
- 3.1.6 In consultation in August 2020, the CDSFB advised that they held no survey information on fish populations for the Burn of Hollandmey, Burn or Ormigill, Link Burn or Rattar Burn, but that the watercourses probably contain brown trout, eels and perhaps lampreys. The CDSFB advised that none of the watercourses are likely to support salmon.
- 3.1.7 The FCRT did not respond to consultation in July 2020 and no fisheries records were returned by the HBRG.

3.2 Fish Habitat Survey

- 3.2.1 This section should be read with reference to **Figure 8.5** of the EIA Report.
- 3.2.2 A description of all of the watercourses surveyed is presented below, including a summary of channel characteristics at the time of survey.
- 3.2.3 Fish habitat data, including channel dimensions, gradient and substrate composition, are included in **Annex 1**. Photographs from each of the sample points are given in **Annex 2**.
- 3.2.4 For all watercourses within the study area the neighbouring land use is predominantly commercial forestry, with sheep and cattle grazing also occurring in parts.

W1 & W2 – Headwater of Burn of Horsegrow

- 3.2.5 Watercourses W1 and W2 both flow in a northerly direction out of the northern boundary of the Site (**Figure 8.5** of the EIA Report).
- 3.2.6 They are unclassified watercourses whose sources are from within the Site. It is one of the two main headwater tributaries that form the Burn of Horsegrow, near the north western extent of the Site. The Burn of Horsegrow then discharges into the Loch of Mey c. 2 km to the north. Ordnance Survey mapping shows straightened drainage ditches which discharge from the Loch of Mey into the North Sea. It is considered that these structures and the loch itself make W1 and W2 sub-optimal routes for migratory fish and it is unlikely that watercourse W1 or W2 support populations of Atlantic salmon or sea trout.

⁵ <https://map.environment.gov.scot/sewebmap/> [Accessed July 2020].

- 3.2.7 Watercourse W1 had a wetted width of between 0.2 m and 0.35 m with a depth varying (at time of survey) from 0.05 m to 0.20 m. Channel gradient is very shallow throughout the whole section of watercourse W1 that lies within the site at c. 1%. Similarly, watercourse W2 is also narrow and shallow in nature, with a wet width range lying between 0.2 m and 0.3 m and depths also measuring between 0.05 m and 0.2 m. Watercourse W2 lies on a similarly shallow gradient.
- 3.2.8 Both watercourses are choked with emergent vegetation largely in the form of soft rush *Juncus effusus*, tufted hairgrass *Deschampsia cespitosa* and bottle sedge *Carex rostrata* (*Category 9 Vegetation Features, Sub-category 9c Emergent macrophytes*), much of which is rooted in the channel. There is also a patch of yellow flag iris *Iris pseudacorus* at the origin of watercourse W1. The flow of both these watercourses, where observable in amongst the dense vegetation, largely comprised of *Category 4a Shallow run*, with very occasional *Category 3 Riffles* observed in watercourse W1 where microtopography is a little steeper.
- 3.2.9 Substrate type throughout watercourse W1 comprises peat, with sand, gravel and occasional pebbles also present. Watercourse W2 has a much larger concentration of peat in its channel bed.
- 3.2.10 Within the Site these watercourses are considered to be unlikely to support fish fauna based on the volume of emergent vegetation that is routed within the channel.

W3 Burn of Ormgill

- 3.2.11 The Burn of Ormgill (watercourse W3) is a tributary of the Link Burn (which feeds into the Burn of Rattar as it flows further north off Site). Watercourse W3 flows west out of the Site before joining the Link Burn at Grottistoft Moss. While watercourse W3 is unclassified, the Link Burn is classified as being in 'Good Ecological Status' and considered to have good access for migratory fish fauna.
- 3.2.12 Watercourse W3 has a wetted width of between 0.25 m and 0.4 m with a depth varying (at time of survey) from 0.15 m to 0.25 m. Channel gradient is shallow throughout the whole section of watercourse W3 that lies within the site at c. 1-2%. Watercourse W3 is also narrow and shallow and homogenous in nature, with a wet width range lying between 0.25 m and 0.4 m and depths also measuring between 0.2 m and 0.3 m.
- 3.2.13 Emergent vegetation has formed a canopy over much of watercourse W3, but there is generally less vegetation that has taken root in the watercourse when compared with watercourse W1 and W2. Flow conditions are slow flowing 'shallow run' throughout its extent within the site.
- 3.2.14 Substrate in the channel bed in watercourse W3 ranges from sand and gravel with occasional pebbles present.
- 3.2.15 Watercourse W3 is sub-optimal in terms of potential salmonid spawning habitat as the gravel is often compacted in sand and in peat. There is little to no marginal silt favoured by juvenile lamprey species and the slow flow conditions and shading from emergent vegetation are likely to have lower levels of oxygen. It is considered likely that watercourse W3 may be used by low numbers of migratory fish such as Atlantic salmon (if at all present) and sea trout and non-migratory fish such as brown trout.

W4 – Unnamed tributary of the Burn of Ormgill

- 3.2.16 Watercourse W4 is an un-named watercourse located in the west of the Site and is a tributary of the Burn of Ormgill.
- 3.2.17 Watercourse W4 is a short section of watercourse, which is very minor in nature, containing little to no running water at the time of survey. Similarly to the upper reaches of watercourses W1 and W2 it is also choked with emergent vegetation rooted in the channel.

3.2.18 In summary, watercourse W4 is considered to comprise *Category 1c Other – ephemeral, shallow drains, dry bed* along its length and which provides no suitable fish habitat.

W5 – Burn of Hollandmay

3.2.19 The Burn of Hollandmay (watercourse W5) is a tributary of the Link Burn. It flows southwest up to its confluence with the Link Burn in the south western section of the Site.

3.2.20 Watercourse W5 has a wetted width of between 0.25 m and 0.4 m with a depth varying (at time of survey) from 0.10 m to 0.20 m. Channel gradient is shallow throughout the whole of watercourse W5 at c. 1-2%. The watercourse is forded by a track which runs in a north/south direction towards Crackerfield. On the east side of the track the banks are heavily poached by cattle. On the west side of the track and past the stockproof fencing, grazing evidence is at a much lower level, concurrent with evidence at watercourses W1-W4. In terms of dimensions watercourse W5 has a wet width range lying between 0.25 m and 0.65 m and depths also measuring between 0.1 m and 0.3 m.

3.2.21 Rank emergent vegetation has formed a canopy over much of W5 in areas with lower grazing, largely comprising soft rush and bottle sedge, which in much of the watercourse has taken root in the channel and choked flow conditions. Where open water is present flow conditions are slow with a flowing *Category 4a Shallow run* status. A short section upstream of the track has a shallow open channel, lacking in the emergent vegetation present over the majority of the watercourse, in this small section there is a *Category 3 Riffle* flow type present.

3.2.22 The substrate in the channel bed in watercourse W5 is varied and ranges from sand and gravel with pebble and cobble present. In the upper reaches there was also slab like rock (although not fixed like bedrock) present.

3.2.23 W5 is considered to be of limited suitability for migratory fish fauna due substantial sections of the channel being choked with emergent vegetation. There is also little to no marginal silt favoured by lamprey species at the nursery stage. It is considered likely that isolated sections of watercourse W5 may be used by low numbers non-migratory fish such as brown trout.

W6 – Link Burn

3.2.24 The Link Burn (watercourse W6) is the most substantial watercourse that runs through the site. It is classified by SEPA as being in good ecological status and there are no known barriers to fish migration. The Link Burn flows through the Site in a predominantly westerly direction. On Site it is fed by the Hollandmay Burn and a series of minor tributaries, which held little to no flow at the time of survey and were homogeneously choked with emergent vegetation dominated by soft rush and tufted hairgrass.

3.2.25 The watercourse had a wet channel width of between 0.35 m and 0.75 m and the depth varied between 0.15 m and 0.45 m over its reach within the Site. As with the other watercourses on Site the channel gradient is very shallow, ranging from 1% - 2%.

3.2.26 The Link Burn is the most substantial watercourse within the Site, but is still minor in nature. Flow conditions, largely comprise *Category 4a Shallow run* conditions and there are also occasional very localised small sections of *Category 3 Riffles* present.

3.2.27 The Link Burn is sub-optimal in terms of potential salmonid spawning habitat as the gravel is often compacted in sand and in peat. There is little to no marginal silt favoured by lamprey ammocoetes.

3.2.28 There are no known barriers to fish migration, however there are occasions where peat banks have collapsed into the channel, causing temporary blockage to fish movement. It is considered likely that the Link Burn may be used by low numbers of migratory fish such as Atlantic salmon (if at all present) and sea trout and non-migratory fish such as brown trout.

W7 - Unnamed tributary of Link Burn

- 3.2.29 Watercourse W7 is a slightly more distinguishable feeder channel to the Link Burn. It is infilled with emergent vegetation on a largely peaty channel bed and with little to no water present at the time of survey.
- 3.2.30 In summary, watercourse W7 is classified as *Category 1c Other – ephemeral, shallow drains, dry bed along* its length and which provides no suitable fish habitat.

W8 – Headwater of West Burn of Gills

- 3.2.31 With the boundary of the Site watercourse W8 has an almost imperceptible channel, and the entire area is comprised of an extensive area of acid flush and blanket bog. The channel of this watercourse properly forms approximately 200 m north of the Site boundary.
- 3.2.32 In summary, the extent of watercourse W8 within the Site is classified as *Category 1c Other – ephemeral, shallow drains, dry bed along* its length and which provides no suitable fish habitat.

W9 & W10 – Headwaters of Gill Burn

- 3.2.33 Short sections of the Headwaters of Gill Burn of fall (watercourses W9 and W10) are located within the eastern edge of the Site. The Gill Burn is a SEPA classified watercourse with good ecological status and is considered to have good access for migratory fish fauna. The channels of watercourses W9 and W10 are open with little emergent vegetation and have a *Category 3 Riffle* flow type. They flow in an easterly direction into roadside drainage prior to being culverted from the Site under an unnamed road into the Gill Burn catchment. The neighbouring land use here is sheep grazing.
- 3.2.34 In summary, the sections of watercourse W9 and W10, which lie within the Site have some access potential for migratory and non-migratory fish fauna, however access and suitability for fish is reduced by the roadside drainage ditches and the very shallow water depths that exist within these watercourses within the confines of the Site. Furthermore there was no suitable habitat recorded for lamprey species. Small numbers of salmonid fish may have the potential to be present.

W11 – Headwaters of Back Burn of Slickly

- 3.2.35 Watercourse W11 is an unclassified watercourse, which lies adjacent and outwith the south east boundary of the Site. The water course forms on the opposite side of the unnamed road which forms the southern Site boundary and there is a lack of hydrological connectivity of this watercourse to the Site.
- 3.2.36 The channel, which flows to the east and away from the Site is peaty in nature and homogenous. It is bounded on both banks by emergent and marginal vegetation dominated with soft rush and tufted hairgrass. There are no known barriers to migratory fish species, however the habitats, due to their homogenous and peaty nature are likely to support only low numbers of fish.

W12 – Headwaters of the Burn of Slickly

- 3.2.37 The head waters of the Burn of Slickly (watercourse W12) that lie within the confines of the southern extent of the Site are almost imperceptible in nature. There was little to no flow in the channel at the time of survey, which like many of the channels within the Site was choked with emergent vegetation and, as a result offering negligible opportunities for fish fauna.
- 3.2.38 In summary, watercourse W12 is classified as *Category 1c Other – ephemeral, shallow drains, dry bed along* its length and which provides no suitable fish habitat.

3.3 Summary

- 3.3.1 Functional fish habitat is relatively restricted within the Site and is considered to be of low sensitivity, given the short extents and low quality habitat recorded. Many of the watercourses are choked by emergent vegetation, resulting in low flow conditions.
- 3.3.2 No significant areas of high calibre *Category 2a Salmonid spawning habitat* were identified within watercourses with the Site, with habitat suitability, where present limited to juvenile fish. The CDSFB has advised that Atlantic salmon are unlikely to be present, although some presence of brown trout, eels and perhaps lampreys is possible. No significant areas of spawning or nursery habitat for lamprey species were however noted and suitable habitat for European eel is limited.

4 REFERENCES

Caithness District Salmon Fisheries Board. (2016). The Flow Country Fisheries Management Organisation (FCFMO). Draft Fisheries Management Plan.

Gardiner, R. (2003) *Identifying Lamprey. A field key for Sea, River and Brook Lamprey*. Conserving Natura 2000 Rivers Conservation Techniques Series No. 4. English Nature, Peterborough.

Harvey, J. & Cowx, I. (2003) *Monitoring the River, Brook and Sea Lamprey, Lampetra fluviatilis, L. planeri and Petromyzon marinus*. Conserving Natura 2000 Rivers Monitoring Series No 5, English Nature, Peterborough.

Hendry, K. & Cragg-Hine, D. (1997) *Restoration of riverine salmon habitats: A guidance manual*. R&D Technical Report W44. Environment Agency, Bristol.

Hendry K & Cragg-Hine D. (2003) *Ecology of the Atlantic Salmon*. Conserving Natura 2000 Rivers Ecology Series No. 7. English Nature, Peterborough.

Maitland, P.S. (2003) *Ecology of the River, Brook and Sea Lamprey*. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

Maitland, P.S. & Campbell, R.N. (1992) *Freshwater Fishes of the British Isles*. New Naturalist. HarperCollins, London.

Mills, D.H. (1973) Preliminary assessment of the characteristics of spawning tributaries of the River Tweed with a view to management. In: M.W. Smith & W.M. Carter (eds.). *International Atlantic Salmon Symposium*, St Andrew's, International Atlantic Salmon Special Publication Series 4 (1), 145-55.

Scottish Fisheries Coordination Centre (SFCC). (2007) Habitat Surveys Training Course Manual

SNIFFER. WFD111 (2a). Coarse resolution rapid assessment methodology to assess obstacles to fish migration: Field Manual Level A Assessment. SNIFFER.

<https://www.sniffer.org.uk/Handlers/Download.ashx?IDMF=8ad81836-e172-4365-9acb-47fa8174aa06>

Youngson, A. (2020). 2019 Survey of Juvenile Salmonids in the Caithness Rivers. Caithness District Salmon Fisheries Board.

ANNEX 1: ENVIRONMENTAL DATA

Sample locations are illustrated on **Figure 8.5** of the EIA Report, with photographic plates are provided in **Annex 2**.

Table A1.1: Environmental data from sample locations from W1

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photographic Plate	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
1	328956 971430	A	0	0	0	20	30	20	30	0.25	0.08	1	1	4a/9d
2	328559 971888	B	0	0	0	30	20	25	25	0.25	0.10	1	1	4a/9d

Table A1.2: Environmental data from sample locations from W2

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
3	328559 971728	C	0	0	0	5	5	<1	90	0.25	0.20	2	1	4a/9d

Table A1.3: Environmental data from sample locations from W3

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
4	328388 970240	D	0	0	5	55	10	10	20	0.28	0.18	1	1	4a/9d

Table A1.4: Environmental data from sample locations from W4

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
5	328479 970372	5	0	0	0	0	0	0	100	0.2	0.05	2	1	1c

Table A1.5: Environmental data from sample locations from W5

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
6	329709 970470	6	0	0	20	40	10	15	15	0.3	0.15	1	1	4a/9d
7	329573 970397	7	0	25	25	15	15	15	05	0.55	0.10	1	1	3
8	329256 970105	8	0	0	0	0	10	10	80	0.40	0.15	1	1	4a/9d

Table A1.6: Environmental data from sample locations from W6 – Un-named.

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
9	328630 969074	9	0	0	0	5	15	10	70	0.40	0.25	1	1-2	4a/9d
10	328548 969011	10	0	0	0	10	20	10	60	0.5	0.30	1	1-2	4a/9d
11	328369 969008	11	0	0	0	5	15	20	60	0.45	0.35	1	1-2	4a/9d
12	328052 969130	12	0	0	5	10	15	15	55	0.45	0.30	1	1-2	4a/9d

Table A1.7: Environmental data from sample locations from W7

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
13	328786 969105	13	0	0	0	5	5	0	90	0.30	0.05	2	1	1c

Table A1.8: Environmental data from sample locations from W8

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
14	331299 971778	14	0	0	0	0	0	0	100	0.2	0.05	2	1	1c

Table A1.9: Environmental data from sample locations from W9

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
15	331381 968882	15	0	5	20	50	10	10	5	0.25	0.08	1	1-2	3

Table A1.10: Environmental data from sample locations from W10

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
16	330919 968354	16	0	0	23	50	10	10	0	0.25	0.07	1	1-2	3

Table A1.11: Environmental data from sample locations from W11

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
17	330463 967712	17	0	0	0	20	20	0	60	0.3	0.2	1	1	4a

Table A1.12: Environmental data from sample locations from W12

Location			Substrate Composition (%)							Channel Information				Habitat Type
Sample No.	Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse sand 0.5 –2 mm	Peat/fine sand/silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
18	328529 967507	18	0	0	0	0	5	5	90	0.20	0.05	1	1-2	1c

ANNEX 2: PHOTOGRAPHIC PLATES

Plate 1:

W1 – Headwater of Horsegrow: Sample Point 1



Plate 2:

W1 – Headwater of Horsegrow: Sample Point 2



Plate 3:

W2 - Headwater of Horsegrow: Sample Point 3



Plate 4:

W3 – Burn of Ormigill: Sample Point 4



Plate 5:

W4 – Unnamed Tributary: Sample Point 5



Plate 6:

W5 – Burn of Hollandmae Sample Point 6



Plate 7:

W5 – Burn of Hollandmae: Sample Point 7



Plate 8:

W5 – Burn of Hollandmae: Sample Point 8



Plate 9:

W6 – Link Burn: Sample Point 9



Plate 10:

W6 – Link Burn: Sample Point 10



Plate 11:

W6 – Link Burn: Sample Point 11



Plate 12:

W6 - Link Burn: Sample Point 12



Plate 13:

W7 – Un-named: Sample Point 13



Plate 14:

W8 – Headwater: West Burn of Gills: Sample Point 14



Plate 15:

W9 - Headwaters of Gills Burn: Sample Point 15



Plate 16:

W10 – Headwaters of Gills Burn: Sample Point 16



Plate 17:

W11 – Headwaters of the Burn of Slickly:
Sample Point 17



Plate 18:

W12 – Un-named: Sample Point 18

